

# Protection against ionizing radiation

Radiodiagnostic imaging methods work with ionizing radiation, which can have harmful consequences. It is necessary to protect yourself from this radiation. The growing spread of radiodiagnostic methods and so-called medical radiation has recently given rise to discussions about their benefits and risks. Medical radiation must always be justified by the benefit to the patient. X-ray imaging can be indicated when a disease is suspected or as part of an approved screening (mammography).

## Sources of medical ionizing radiation

**Ionizing radiation is produced during examination:**

- skiagraphy;
- fluoroscopy;
- angiography;
- CT;
- all radionuclide methods (PET, scintigraphy);
- radionuclide and radiation therapy (brachytherapy and teletherapy).

**Ionizing radiation does not occur when:**

- ultrasonography;
- magnetic resonance imaging.

## Effects of ionizing radiation

- **Stochastic:** can occur at any dose (non-threshold action), they are conditioned by an induced DNA disorder leading to carcinogenesis. The lifetime risk of dying from a malignant tumor is estimated to be around 5% per 1 Sv.<sup>[1]</sup>
- **Deterministic:** arise only when the threshold dose is exceeded (which is very high, in the order of Sv units), have a characteristic image and should never occur during medical radiation. These are, for example, acute radiation sickness, radiation dermatitis, marrow depression, burns.

 For more information see *Deterministic effects of ionizing radiation*.

## Principles of protection against ionizing radiation

- **ALARA:** As Low As Reasonably Achievable: dose should be as low as reasonably achievable:
  - too high a dose - unnecessarily burdens the patient;
  - sufficient dose - the patient is minimally burdened and the goal (diagnostic or therapeutic) has been reached = **ALARA**;
  - insufficient dose - the performance must be repeated and the sum then exceeds the sufficient dose.
- **Shielding:** shielding reduces ionizing radiation exponentially, but not completely. During the examination, the gonads and the fetus can be shielded, and it is also necessary to use the maximum deflection of the beam.
- **Distance:** the amount of radiation decreases with the square of the distance: the further you are from the emitter, the less ionizing radiation hits you.
- **Time:** shorten the examination (e.g. fluoroscopy) to a minimum, use the pulse mode (the light source e.g. 4x per second).

**It is always necessary to consider whether:**

- I need an examination;
- I need an examination now;
- is not an alternative to an examination with a lower radiation dose.

It is a principle of good clinical practice to find out what tests the patient has undergone so that some of the tests are not repeated unnecessarily. Usual radiation doses for routine examinations are known (MZČR gazette, UNSCEAR reports).

## Ionizing radiation doses for examination

**According to the MZČR Bulletin from 11/2003, typical effective doses are classified into 5 classes:**

- **0** (0 mSv): ultrasonography, MRI;
- **I** (< 1 mSv): X-ray images of limbs, chest, skull, hips, pelvis, thoracic spine; mammography;
- **II'** (1-5 mSv): X-ray images of abdomen, lumbar spine; act of swallowing; IVU; CT head and neck; radionuclide examination of pulmonary ventilation (Xe-133), pulmonary perfusion, kidneys, thyroid gland and bones (Tc-99m);
- **III** (5-10 mSv): CT chest, abdomen, pelvis; irigoscopy; dynamic myocardial scintigraphy (Tc-99m); PET heads

(F-18 FDG);

- **IV** (> 10 mSv): PET.<sup>[2]</sup>

In the journal, there is a guideline for the indication of diagnostic imaging methods **Indication criteria for imaging methods**, which was taken from the **Referral guidelines for imaging** issued by the European Commission in cooperation with the UK Royal College of Radiologists .

"Act No. 18/1997 Coll., on the peaceful use of nuclear energy and ionizing radiation" and "Decree No. 307/2002 Coll. on radiation protection *divides dose limits into four categories: general limits, professional limits, student and apprentice limits and limits for exposure in special cases.*

*Medical radiation (whether diagnostic or therapeutic) is not subject to any limits, so the scope of examination or therapy is not legally limited.*

 For more information see *Legislative requirements for handling sources of ionizing radiation.*

## Links

### Related Articles

- Ionizing radiation
- Contrast agents

### External links

- SÚJB: State Institute for Nuclear Safety (<https://www.sujb.cz/uvod/>)
- UNSCEAR: UN Scientific Committee on the Effects of Atomic Radiation (<http://www.unscear.org>)
- ICRP: International Commission on Radiological Protection (<http://www.icrp.org/>)
- Learning portal 1. LF UK – Radiodiagnostics: Quiz Protection against ionizing radiation during radiodiagnostic examinations (<https://el.lf1.cuni.cz/p73227280/>)

### References

1. KUPKA, Karel – KUBINYI, Joseph – ŠAMAL, Martin. *Nuclear Medicine*. 1. edition. P3K, 2007. 185 pp. ISBN 978-80-903584-9-2.
2. Czech Republic. MZČR. Journal 11/2003 Indication criteria for imaging methods. 2003. Available from <[http://www.mzcr.cz/Legislativa/dokumenty/vestnik\\_3662\\_1782\\_11.html](http://www.mzcr.cz/Legislativa/dokumenty/vestnik_3662_1782_11.html)>.

### References

- KUPKA, Karel – KUBINYI, Joseph – ŠAMAL, Martin. *Nuclear Medicine*. 1. edition. P3K, 2007. 185 pp. pp. 26-27. ISBN 978-80-903584-9-2.